Amendments to the Claims:

The following listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 1.-43. (Canceled)

44. (New) A projection optical system for projecting an image of a first plane (OP) onto a second plane (IP) comprising:

a boundary lens (E233); and

at least one layer of immersion liquid (IL) between the boundary lens (E233) and the second plane (IP);

said boundary lens (E233) having a first plane side optical surface (S263) shaped such that for light projected onto the second plane (IP) through the boundary lens (E233) the marginal ray convergence angle (L) prior to incidence is larger than the marginal ray convergence angle (S) within said boundary lens (E233).

45. (New) The projection optical system of Claim 44 further comprising:
at least one positive powered lens element (E231, E232) proximal to said boundary lens (E233), and having an aspheric optical surface (S259, S260, S261, S262).

46. (New) The projection optical system of Claim 44 wherein there are provided:

a first positive powered lens element (E231) proximal to said boundary lens (E233), and having at least one aspheric optical surface (S259, S260); and

a second positive powered lens element (E232) between the first positive powered lens element (E231) and said boundary lens (E233), and having at least one aspheric optical surface (S261, S262).

47. (New) The projection optical system of Claim 44, further comprising a double-Gauss anastigmat arranged to reduce spherical aberration including a third positive powered lens element (E222), a first negative powered lens element (E223), a second negative powered lens element (E224), and a fourth positive powered lens element (E225).

48. (New) The projection optical system of Claim 47 further comprising a catadioptric anastigmat comprising a concave mirror (E215) and at least one negative powered Schupmann lens (E213, E214).

49. (New) The projection optical system of Claim 48 wherein the catadioptric anastigmat comprises two negative powered Schupmann lenses (E213, E214).

50. (New) The projection optical system of Claim 49 adapted for use with ultraviolet light.

51. (New) An exposure apparatus comprising an illuminating system for illuminating a mask set on the first plane (OP), and a projection optical system according to Claim 44 for forming an image of a pattern formed on said mask on a photosensitive substrate set on the second plane (IP).

52. (New) An exposing method comprising the steps of illuminating a mask set on the first plane (OP), and projecting and exposing a pattern image formed on said mask on a photosensitive substrate set on the second plane (IP) via the projection optical system according to Claim 44.

53. (New) A projection optical system for projecting an image of a first plane (OP) to a second plane (IP) comprising:

an optical system;

a boundary lens (E233); and

at least one layer of immersion liquid (IL) between said boundary lens (E233) and said second plane (IP); wherein

light from the first plane (OP) is transmitted through the optical system, and output with a predetermined marginal ray convergence angle (L); and

said boundary lens (E233) is positioned to receive said light output from the optical system, and adapted such that for light projected onto the second plane (IP) through the boundary lens (E233) the marginal ray convergence angle (L) prior to incidence is larger than the marginal ray convergence angle (S) within said boundary lens (E233).

54. (New) The projection optical system according to Claim 53 wherein the optical system comprises:

at least one positive powered lens element (E231, E232) proximal to said boundary lens (E233), and having an aspheric optical surface (S259, S260, S261, S262).

55. (New) The projection optical system of Claim 53 wherein the optical system comprises:

a first positive powered lens element (E231) proximal to said boundary lens (E233), and having at least one aspheric optical surface (S259, S260); and

a second positive powered lens element (E232) between the first positive powered lens element (E231) and said boundary lens (E233), and having at least one aspheric optical surface (S261, S262).

56. (New) The projection optical system of Claim 53 wherein the optical system comprises:

a double-Gauss anastigmat arranged to reduce spherical aberration including a third positive powered lens element (E222), a first negative powered lens element (E223), a second negative powered lens element (E224), and a fourth positive powered lens element (E225).

57. (New) The projection optical system of Claim 56 wherein the optical system further comprises a catadioptric anastigmat comprising a concave mirror (E215) and at least one negative powered Schupmann lens (E213, E214).

58. (New) The projection optical system of Claim 57 wherein the catadioptric anastigmat comprises two negative powered Schupmann lenses (E213, E214).

59. (New) The projection optical system of Claim 58 adapted for use with ultraviolet light.

60. (New) An exposure apparatus comprising an illuminating system for illuminating a mask set on the first plane (OP), and a projection optical system according to Claim 53 for forming an image of a pattern formed on said mask on a photosensitive substrate set on the second plane (IP).

61. (New) An exposing method comprising the steps of illuminating a mask set on the first plane (OP), and projecting and exposing a pattern image formed on said mask on a photosensitive substrate set on the second plane (IP) via the projection optical system according to Claim 53.

62. (New) A method of projecting an image of a first plane onto a second plane (IP) including the steps of:

passing light having a first marginal ray convergence angle (L) to a boundary lens (E233);

passing light having a second marginal ray convergence angle (S) though the boundary lens (E233); and

passing light from said boundary lens (E233) through a layer of immersion liquid (IL) to the second plane (IP); wherein

the first marginal ray convergence angle (L) is greater than the second marginal ray convergence angle (S).

63. (New) The projection method of Claim 62 including the step of passing light through at least one positive powered lens element (E231, E232) proximal to said boundary lens (E233), and having an aspheric optical surface (S259, S260, S261, S262).

64. (New) The projection method of Claim 62 including the steps of:

passing light through a first positive powered lens element (E231) proximal to said boundary lens (E233), and having at least one aspheric optical surface (S259, S260); and

passing light through a second positive powered lens element (E232) between the first positive powered lens element (E231) and said boundary lens (E233), and having at least one aspheric optical surface (S261, S262).

65. (New) The projection method of Claim 64 further including the step of passing light through a double-Gauss anastigmat arranged to reduce spherical aberration including a third

positive powered lens element (E222), a first negative powered lens element (E223), a second negative powered lens element (E224), and a fourth positive powered lens element (E225).

66. (New) The projection method of Claims 65 including the step of passing light through a catadioptric anastigmat comprising a concave mirror (E215) and at least one negative powered Schupmann lens (E213, E214).

67. (New) The projection method of Claim 66 including the step of passing light through two negative powered Schupmann lenses (E213, E214).

68. (New) The projection method of Claim 67 wherein said light is a beam of ultraviolet light.

69. (New) An exposure apparatus comprising an illuminating system for illuminating a mask set on the first plane (OP), and a projection optical system according to Claim 62 for forming an image of a pattern formed on said mask on a photosensitive substrate set on the second plane (IP).

70. (New) An exposing method comprising the steps of illuminating a mask set on the first plane (OP), and projecting and exposing a pattern image formed on said mask on a photosensitive substrate set on the second plane (IP) via the projection optical system according to Claim 62.

71. (New) A projection optical system for projecting an image of a first plane (OP) onto a second plane (IP), comprising:

an optical path having a plurality of lenses including a boundary lens which is arranged at a position closest to the second plane, wherein the first plane (OP) side surface of the boundary lens has a positive refractive power, and for an atmosphere in said optical path having a refractive index of 1, the optical path between said boundary lens and said second plane (IP) is filled with a medium having a refractive index larger than 1.1.

72. (New) The projection optical system according to Claim 71, which satisfies the condition as expressed by:

$$0.012 < Cb \cdot D/NA < 0.475$$

where, Cb represents the curvature of said boundary lens on the first plane (OP) side; D represents the distance between an optical axis and the outermost point of an effective image forming area, and NA represents the numerical aperture on the second plane (IP) side of the boundary lens.

73. (New) The projection optical system according to Claim 72, wherein at least one optical member (Lp) having substantially no refractive power is arranged in the optical path between said boundary lens and said second plane (IP); and the optical path between said boundary lens and said optical member, and the optical path between said optical member and said second plane (IP) are filled with said medium.

74. (New) The projection optical system according to Claim 71, wherein at least one optical member (Lp) having substantially no refractive power is arranged in the optical path between said boundary lens and said second plane (IP); and the optical path between said boundary lens and said optical member, and the optical path between said optical member and said second plane (IP) are filled with said medium.

75. (New) The projection optical system according to Claim 74, wherein said at least one optical member having substantially no refractive power is detachably arranged in the optical path between said boundary lens and said second plane (IP).

76. (New) The projection optical system according to Claim 75, wherein the optical member having substantially no refractive power has an adjustable orientation.

77. (New) The projection optical system according to Claim 74, wherein the optical member having substantially no refractive power has an adjustable orientation.

78. (New) The projection optical system according to Claim 74, wherein said projection optical system satisfies the condition as expressed by:

$$|P \cdot D| < 1.0 \times 10^{-4}$$

where, P represents the refractive power of said optical member having substantially no refractive power, and D represents the distance between the optical axis and the outermost point of the effective image forming area.

79. (New) The projection optical system according to Claim 71, wherein said projection optical system is a catadioptric optical system comprising at least one concave reflector.

80. (New) The projection optical system according to Claim 79, having an effective image forming area eccentric relative to the optical axis, wherein at least one intermediate image is formed in said optical path of said projection optical system.

81. (New) The projection optical system according to Claim 80, comprising one image forming optical system (G2), having said at least one concave reflector, for forming said intermediate image; and another image forming optical system (G3) for forming a final image on said second plane (IP) on the basis of the flux from said the intermediate image; and

a deflecting mirror arranged in the optical path between said one image forming optical system and said another image forming optical system.

82. (New) The projection optical system according to Claim 81, wherein the following conditional expression is satisfied:

$$0.75 < MA/MG3 < 1.1$$

where, MA denotes a magnification of the whole optical system, and MG3 denotes a magnification of the another imaging optical system (G3).

83. (New) The projection optical system according to Claim 81, wherein said another image forming optical system (G3) includes an aperture stop, and wherein the number of lens elements arranged on the second plane (IP) side of the aperture stop is five or less.

84. (New) The projection optical system according to Claim 83, wherein all lens elements arranged between the second plane (IP) and the aperture stop in the third image forming optical system have positive refractive power.

85. (New) The projection optical system according to Claim 83, wherein no lens element having negative refractive power is included in the lens elements arranged in the second plane (IP) side of the aperture stop.

86. (New) The projection optical system according to Claim 80, comprising a first image forming optical system (G1) for forming a first intermediate image of said first plane (OP); a second image forming optical system (G2), having said at least one concave reflector, for forming a second intermediate image on the basis of said first intermediate image; and a third image forming optical system (G3) for forming a final image on said second plane (IP) on the basis of the flux from said second intermediate image; wherein:

a first deflecting mirror is arranged in the optical path between said first image forming optical system and said second image forming optical system; and a second deflecting mirror is arranged in an optical path between said second image forming optical system and said third image forming optical system.

87. (New) The projection optical system according to Claim 86, wherein the optical axis of said first image forming optical system is aligned with the optical axis of said third image forming optical system.

88. (New) The projection optical system according to Claim 87, wherein the following conditional expression is satisfied;

$0.75 < MA/MG3 < 1.1$

where, MA denotes a magnification of the whole optical system, and MG3 denotes a magnification of the third imaging forming optical system (G3).

89. (New) The projection optical system according to Claim 86, wherein the following conditional expression is satisfied;

$0.75 < MA/MG3 < 1.1$

where, MA denotes a magnification of the whole optical system, and MG3 denotes a

magnification of the third imaging forming optical system (G3).

90. (New) The projection optical system according to Claim 71, wherein the numerical aperture on the first plane (OP) side is 0.22 or larger.

91. (New) The projection optical system according to Claim 71, wherein the light quantity loss occurring upon passing through said medium is 50% or lower.

92. (New) An exposure apparatus comprising an illuminating system for illuminating a mask set on a first plane (OP), and a projection optical system according to Claim 71 for forming an image of a pattern formed on said mask on a photosensitive substrate set on said second plane (IP).

93. (New) An exposing method comprising the steps of illuminating a mask set on a first plane (OP), and projecting and exposing a pattern image formed on said mask on a photosensitive substrate set on a second plane (IP) via the projection optical system according to Claim 71.

94. (New) A projection optical system for projecting an image of a first plane (OP) onto a second plane (IP) comprising:

a plurality of optically transparent members,

wherein an optical path between the second plane and a first optically transparent member of the plural optically transparent members which is arranged in a position nearest to the second plane and the second plane is filled with a first medium,

an optical path between the first optically transparent member and a second optically transparent member arranged in adjacent to the first plane side of the first optically transparent member is filled with a second material, and

the first and second medium have a refractive index larger than 1.1, for an atmosphere having a refractive index of 1.

95. (New) The projection optical system according to claim 94, wherein the first and second medium are the same in a kind of the medium.

96. (New) The projection optical system according to claim 95, wherein the first optically transparent member has substantially no refractive power.

97. (New) The projection optical system according to Claim 96, wherein said projection optical system satisfies the condition as expressed by:

$$|P \cdot D| < 1.0 \times 10^{-4}$$

where, P represents the refractive power of said first optically transparent member, and D represents the distance between the optical axis and the outermost point of the effective image forming area.

98. (New) The projection optical system according to claim 94, wherein the first optically transparent member has substantially no refractive power.

99. (New) The projection optical system according to claim 98, wherein the first optically transparent member is insertable in an optical path between the second optically transparent member and the second plane.

100. (New) The projection optical system according to claim 98, wherein the first optically transparent member has an adjustable orientation.

101. (New) The projection optical system according to claim 98, wherein a surface of the second optically transparent member which faces to the first plane have positive refractive power.

102. (New) The projection optical system according to claim 101, which satisfies the condition as expressed by:

$$0.012 < Cb \cdot D/NA < 0.475$$

where, Cb represents the curvature of a plane of the second optically transparent member which faces to the first plane; D represents the distance between an optical axis and the outermost point of an effective image forming area, and NA represents the numerical aperture on the second plane side of the projection optical system.

103. (New) The projection optical system according to claim 94, wherein the first optically transparent member is insertable in an optical path between the second optically transparent member and the second plane.

104. (New) The projection optical system according to claim 94, wherein the numerical aperture on the first plane side is 0.22 or larger.

105. (New) The projection optical system according to claim 94, wherein the first optically transparent member has an adjustable orientation.

106. (New) The projection optical system according to claim 94, wherein the plurality of the optically transparent member are made of fused silica or calcium fluoride.

107. (New) The projection optical system according to claim 106, wherein the first optically transparent member is made of fused silica.

108. (New) The projection optical system according to claim 107, wherein all of the plurality of the optically transparent members is made of fused silica.

109. (New) The projection optical system according to claim 106, wherein the first optically transparent member is made of calcium fluoride.

110. (New) The projection optical system according to claim 94, wherein the first optically transparent member is a plane parallel plate, and the second optically transparent member is a plano-convex lens.

111. (New) The projection optical system according to claim 94, wherein a space between a partially area on the second plane and the first optically transparent member is filled with the first medium.

112. (New) An exposure apparatus for transferring a predetermined pattern on a photosensitive substrate, comprising a projection optical system according to claim 94, for projecting an image of a mask arranged in the first plane onto a photosensitive substrate arranged in the second plane.

113. (New) The exposure apparatus according to claim 112, wherein a scanning exposure is performed by relative movement of the projection optical system and the photosensitive substrate.

114. (New) An exposure method of transferring a predetermined pattern on a photosensitive substrate, comprising a step of, using a projection optical system according to claim 94, projecting an image of a mask arranged in the first plane on a photosensitive substrate arranged in the second plane.

115. (New) The exposure method according to claim 114, comprising a step of performing a scan exposure with relative movement of the projection optical system and the photosensitive substrate.